

**MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE**

**Interface Control Document (ICD)  
Between the  
Earth Observing System (EOS)  
Data and Information System (EOSDIS)  
Backbone Network (EBnet) and the  
EOSDIS Test System (ETS)**

**September 1997**



National Aeronautics and  
Space Administration

Goddard Space Flight Center  
Greenbelt, Maryland

# **Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and the EOSDIS Test System (ETS)**

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# Preface

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This document is under the configuration management of the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Nascom CCB, along with supportive material justifying the change. Changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

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## Abstract

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This Interface Control Document (ICD) describes interface agreements between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and the EOSDIS Test System (ETS).

**Keywords:** *EBnet, EOSDIS Test System, ETS, ICD, interface control document*

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## Abbreviations and Acronyms

# **Section 1. Introduction**

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## **1.1 Authority and Responsibility**

The Mission Operations and Data Systems Directorate (MO&DSD) has the authority to implement Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet). This authority was granted to the MO&DSD by the EOS project, under the Office of Mission to Planet Earth (Code Y). The EBnet project is under the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division of the MO&DSD.

Code 540 will provide an operational communications network to support high-speed network communications between EBnet and non-EBnet hosts. The primary responsibility for this project has been assigned to the Nascom Division, Code 540. The system requirements are documented by the references in Section 2.1.

## **1.2 Purpose**

The purpose of this document is to provide a detailed definition of the interface(s) between the EBnet and the EOSDIS Test System (ETS).

## **1.3 Scope**

This document defines and specifies the data transport interfaces (i.e., protocols, standards applied, physical connections, and locations connected) between EBnet and the ETS.

## **1.4 Time Frame**

This Interface Control Document (ICD) shall be in effect from the date of the last approval signature.

## **1.5 Goals and Objectives**

The goals of EBnet are to:

- a. Implement an operational, integrated, transparent communications system that serves the data communications needs of projects supported by NASA Goddard Space Flight Center (GSFC), and users outside the MO&DSD.
- b. Expand using industry standard system solutions while maintaining compatibility with the existing network and user interfaces.
- c. Minimize costs for implementation, operation, and maintenance of the network.
- d. Minimize life-cycle costs.

- e. Maintain high availability by designing with redundancy, and without single points of failure in the Network Backbone, where required.
- f. Utilize state-of-the-art technology, utilizing equipment with the best price-performance available commercially.
- g. Allow for growth, adaptability to changing requirements, infusion of new technology, and upgraded interfaces throughout the life-cycle.

## **1.6 Standards Precedence**

EBnet will be based on Government, commercial, and international standards. In case of conflict, the following precedence (in descending order) applies:

- This EBnet ICD.
- Government standards.
- Commercial and/or international standards.

## **1.7 Document Organization**

Section 2 contains parent, applicable, and reference documents related to this ICD.

Section 3 details a systems overview of the EBnet and the ETS.

Section 4 describes the ETS–Low-Rate System (LRS) interface.

Section 5 describes the ETS–High-Rate System (HRS) interface.

Section 6 describes the ETS–Multimode Portable Simulator (MPS) interface.

Section 7 describes the facilities and maintenance demarcation.

A list of abbreviations and acronyms is provided at the end of the document.

## Section 2. Related Documentation

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### 2.1 Parent Documents

- [1] *Earth Observing System AM-1 Detailed Mission Requirements*, Goddard Space Flight Center (GSFC), 505-10-33, November 1996
- [2] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume 6, EOSDIS Backbone Network (EBnet) Requirements*, Goddard Space Flight Center (GSFC) 505-10-01-6, Revision A, December 1996
- [3] *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document (IRD)*, September 1997
- [4] Reserved

### 2.2 Applicable Documents

- [4] *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, Electronic Industries Association (EIA) 422-A, December 1978
- [5] *General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, EIA 449, November 1977
- [6] *The Ethernet: A Local Area Network Data Link Layer and Physical Layer Specification*, Digital Equipment Corporation, Intel Corporation, and Xerox Corporation, Version 2.0, November 1982
- [7] *Internet Protocol (IP): DARPA Internet Program Protocol Specification*, Request for Comment (RFC) 791, September 1981
- [8] *Internet Control Message Protocol*, RFC 792, September 1981
- [9] *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48-bit Ethernet Addresses for Transmission on Ethernet Hardware*, RFC 826, November 1982
- [10] *A Standard for the Transmission of IP Datagrams Over IEEE 802 Networks*, RFC 1042, February 1988
- [11] *Internet Group Multicast Protocol (IGMP)*, RFC 1112
- [12] *Routing Information Protocol (RIP)*, RFC 1058
- [13] *Open Shortest Path First (OSPF)*, RFC 1247
- [14] *Transmission of IP over Fiber Distributed Data Interface (FDDI)*, RFC 1188

- [15] International Organization for Standardization (ISO) 9314-1, *FDDI Physical Layer Protocol (PHY)*
- [16] ISO 9314-2, *FDDI Media Access Control (MAC) Protocol*
- [17] ISO 9314-3, *FDDI Physical Layer Medium Dependent (PMD)*
- [18] ISO 8802-2, *Logical Link Control (LLC)*
- [18a] *Simple Network Management Protocol (SNMP)*, RFC 1157
- [18b] *Structure of Management Information*, RFC 1155
- [18c] *Management Information Base - II*, RFC 1213
- [18d] ISO 8802-3, *Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet version 2*
- [18e] Institute of Electrical and Electronic Engineers (IEEE) 802.3 *10Base-T (twisted pair)*

## 2.3 Reference Documents

- [19] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume 2, EOS Data and Operations System (EDOS) and EOS Communications (Ecom) Requirements*, GSFC 423-35-01, March 17, 1992
- [20] Reserved
- [21] *NASA Communications (Nascom) Access Protection Policy and Guidelines*, 541-107, Revision 3, GSFC, November 1995
- [22] *Earth Observing System (EOS) Communication Security Requirements*, NASA 540-214.1, April 1993
- [23] *Earth Observing System Data and Information System (EOSDIS) Test System (ETS) Systems Design Specification*, 515-4SDD/0195, May 1995
- [24] *ETS Detailed Design Specification, Volume 2: Multimode Portable Simulator (MPS)*, 515-DDS-001, March 1996
- [25] *ETS Detailed Design Specification, Volume 3: High-Rate System (HRS)*, 521-DDS-xxx, March 1996
- [26] *ETS Detailed Design Specification, Volume 4: Low-Rate System (LRS)*, 521-DDS-001, March 1996
- [27] *Nascom IP Operational Network (IONET) Users Guide*, 541-225, Revision 1, March 1996
- [28] *ETS Functional and Performance Requirements*, 515-4FRD/0294, March 1996

## Section 3. Systems Overview

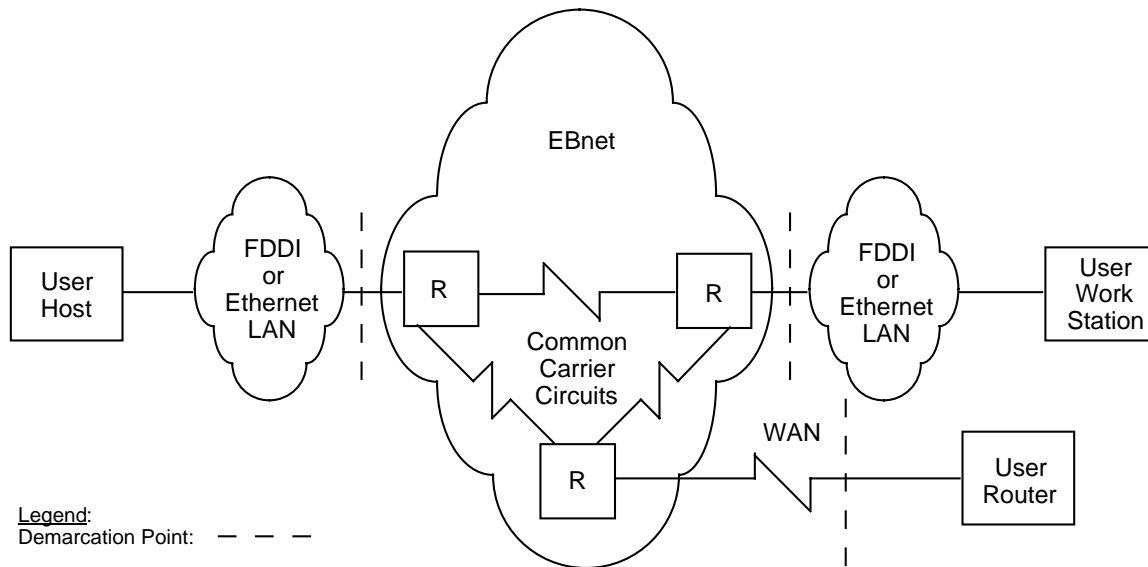
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### 3.1 EBnet General System Description

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 3-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet capability to transport these diverse types of data is implemented as two distinct subnetworks referred to as “real-time” and “science” networks. The real-time network transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as prelaunch testing and launch support. This highly redundant network provides an operational availability of 0.9998 with a Mean Time to Restore Service (MTTRS) of 1 minute. The science network transports data collected from spacecraft instruments and various levels of processed science data, including Expedited Data Sets (EDSs), Production Data Sets (PDSs), and rate-buffered science data. The science network provides an operational availability of 0.98 with an MTTRS of 4 hours.

In addition to providing the wide area communications through common-carrier circuits for internal EOSDIS communications, EBnet serves as the interface to other systems such as the Distributed Active Archive Centers (DAACs), users, and NASA Internet (NI). EBnet also includes exchange Local Area Networks (LANs) that provide communications between the Wide Area Network (WAN) and site-specific LANs. Figure 3-2 depicts EBnet interfaces and demarcations.





**Figure 3-2. EBnet Demarcations**

Sustaining engineering, preventive and remedial maintenance, and network monitoring services are provided for EBnet equipment, to ensure that EBnet keeps pace with technology and standards, and provides continuous service. The official point of contact for EBnet operational status is the Nascom Communications Manager (301-286-6141). Users who detect a network problem are urged to immediately report it to the Communications Manager (COMMGR.) The COMMGR may also provide users with limited information about maintenance and status actions. Refer to the Nascom IP Operational Network (IONET) User Guide (541-225) for information regarding user connections, security guidelines, and maintenance information.

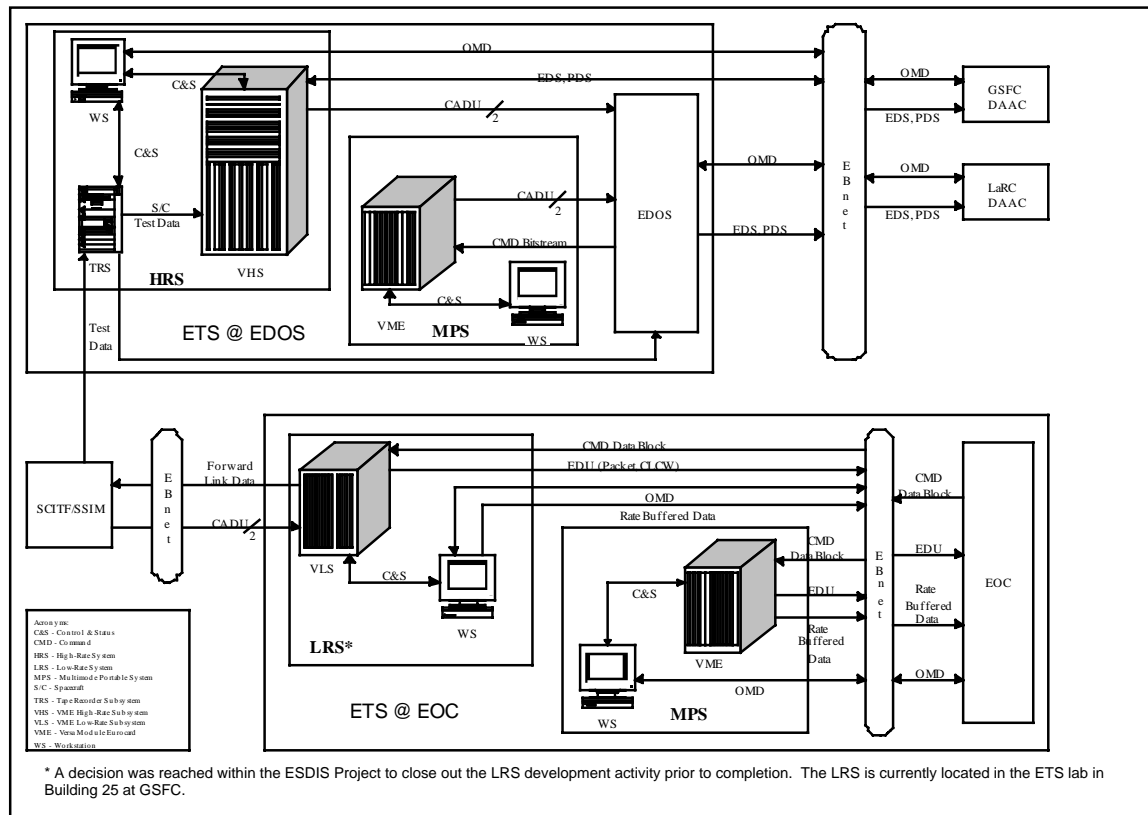
## 3.2 ETS Description

ETS provides testing capabilities used to support EOSDIS integration and test activities during the EOS AM-1 mission life cycle. An extensive ground network is being assembled that will support this and subsequent EOS spacecraft.

Functionally, ETS comprises three different systems: the High-Rate System (HRS), the Low-Rate System (LRS), and the Multimode Portable Simulator (MPS). Figure 3-3 shows the three systems and the EOSDIS elements with which they interface. Collectively, these systems provide capabilities to support high-rate simulations, low-rate simulations, and spacecraft simulations. Each of these functions is described below.

*High rate* refers to the Ku-band science data stream input to EOS Data and Operations System (EDOS) and the resultant EDOS output products. *Low rate* simulations refer to the generation and processing of the S-band telemetry and spacecraft commands. The ETS HRS generates and transmits spacecraft science data and serves as a source and

destination for EDOS data sets. Two different ETS systems perform the low-rate functions. The ETS



**Figure 3-3. ETS Architecture**

LRS is used for providing EDOS low-rate processing of external sources of spacecraft telemetry and command data. The LRS development was closed out in June 1997. The other low-rate system, the ETS MPS, is used for supporting simulations involving spacecraft commands and low-rate telemetry.

### 3.2.1 ETS High-Rate Simulation Functions

The ETS-HRS is used to support EDOS test and simulation activities. It is collocated with EDOS in Building 32 at GSFC. The ETS-HRS is used to perform four main functions:

- Simulate science return-link data streams.
- Capture EDOS-produced data sets.
- Verify format of EDOS-produced data sets from ETS-transmitted data.
- Simulate EDOS data sets.

The ETS-HRS is used to simulate the solid-state recorder playback of science data. ETS transmits the data in the form of Channel Access Data Units (CADUs) as a serial clock and data stream to the EDOS interface at the White Sands Complex (WSC) as if the data were being transmitted by the Tracking and Data Relay Satellite System (TDRSS) Ground Terminal (TGT) or as if through the Domsat hop from WSC to the EDOS facility at GSFC. ETS will be able to provide two streams of science playback data for input to EDOS. Data tapes are used to provide the 150 megabits per second (Mbps) input data source to EDOS at WSC, and the ETS-HRS provides the two simulated rate-buffered data streams into EDOS at GSFC at 45 Mbps. EBnet is not used to support these ETS clock and data interfaces to EDOS.

The ETS-HRS also is involved in testing the EDOS and DAAC interfaces for transmission and reception of actual or simulated EDOS data sets and associated Operations Management Data (OMD) messages. The ETS-HRS is able to simulate a DAAC interface for EDOS by capturing the output from EDOS processing. EDOS products will include EDSs and PDSs. ETS is able to capture data set file transfers from EDOS up to an ETS storage capacity of 25 gigabytes (GB) and at data rates up to 34 Mbps.

ETS is able to store and later check the structure and format of the data it receives from EDOS. If ETS is used to generate the spacecraft data input to EDOS, it is also able to generate another data set containing the expected output from the EDOS processing of that data.

The ETS-HRS is able to simulate the EDOS interface for a DAAC by transmitting EDOS data sets. ETS can process a CADU input stream to generate expected EDOS output and create data sets, or it can generate simulated EDOS data sets using an ETS data generation utility. For tests with a DAAC, ETS is used to transmit prerecorded data sets that a DAAC can process. ETS is able to transmit data sets to a DAAC with a rate of up to 34 Mbps. ETS relies on EBnet for data transport services for the test data sets and OMD messages.

### **3.2.2 ETS Low-Rate EDOS Simulation Functions**

(A decision was reached within the ESDIS Project in June 1997 to close out the LRS development activity, prior to its completion. The LRS is currently located in the ETS lab in Building 25 at GSFC).

The ETS-LRS will support initial tests of the spacecraft with the EOS Operations Center (EOC) by performing some EDOS low-rate return- and forward-link processing functions. This enables the EOC to interface with the Spacecraft Checkout Station (SCS), located in the Spacecraft Integration and Test Facility (SCITF) in Valley Forge, Pennsylvania (VFPA). ETS capabilities will also be used for the EOS AM-1 Spacecraft Simulator (SSIM) being developed by the spacecraft manufacturer as a training simulator for the EOC Flight Operations Team (FOT).

For low-rate return-link data, the ETS-LRS will receive CADUs from the SCS or SSIM, frame synchronize the data, Reed-Solomon decode and correct the data, extract and

annotate the packets, extract the Command Link Control Words (CLCWs), and transmit the real-time data packets and CLCWs in the form of EDOS Data Units (EDUs) and the low-rate playback housekeeping data as rate-buffered data files to the EOC. For forward-link data, the ETS-LRS will receive the spacecraft commands from the EOC in the form of command data blocks, will remove the EDOS ground message headers, and will transmit the forward-link data as command bit streams to the SCS or SSIM.

The ETS-LRS will be collocated with the EOC in Building 32 at GSFC. EBnet will provide the clock and data interface between the ETS-LRS and the SCITF in VFPA, when both the SCS and SSIM are located there. However, when the SSIM is relocated to the EOC facility, the clock and data interfaces between SSIM and ETS will be supplied by RS-422 serial interface cables and, thus, will not require EBnet involvement.

### **3.2.3 ETS Low-Rate Spacecraft Simulation Functions**

The ETS-MPS generates the basic S-band spacecraft telemetry data formats, including the housekeeping, health and safety, diagnostic, and playback data formats. The ETS-MPS receives and verify commands according to Command Operations Procedure (COP-1) protocol. The ETS-MPS provides limited spacecraft simulation and dynamic interaction. The ETS-MPS can respond in telemetry to operator and spacecraft commands.

The ETS-MPS operates in three data format modes: serial spacecraft data for nominal Space Network (SN) operations, Nascom 4800-bit blocks for contingency network operations (although this format is no longer needed for EOS AM-1 ground network support.) and Internet Protocol (IP) formats (e.g., EDUs, command data blocks) for communication with EOC without requiring EDOS. The serial mode does not require EBnet because it uses a direct cable connection for the clock and data. The third MPS format mode, however, requires an IP interface and therefore requires an EBnet interface.

The ETS-MPS is portable and can support ground network testing from various test sites. There are two MPS units. One unit is home-based at the EOC facility in Building 32 and supports both EOC and EDOS testing. The second MPS unit is currently located in the ETS lab in Building 25 (Rm N155) but will later be located to the EDOS facility in Building 32.

## **3.3 Relationship Between ETS and EBnet**

The relationship between the ETS and EBnet is to support connectivity between the ETS, the EOC, EDOS, DAACs, and the SCITF. All data flows between the ETS and the EOSDIS elements supported by EBnet are considered to be science traffic. (For the purpose of EBnet ICDs, any traffic type that is not real time is considered to be science traffic.) It is recognized that the ETS will be simulating the flow of real-time data to the EOC. EBnet will provide a real-time level of service in terms of supported protocols (e.g., multicasting) but provides a science data level of reliability since the simulated data flow is not considered to be mission critical. All the ETS units, the EOC, and EDOS are

located at GSFC. The SCITF is located at Valley Forge, PA. Only the ETS-HRS requires connectivity to the EBnet wide area links.

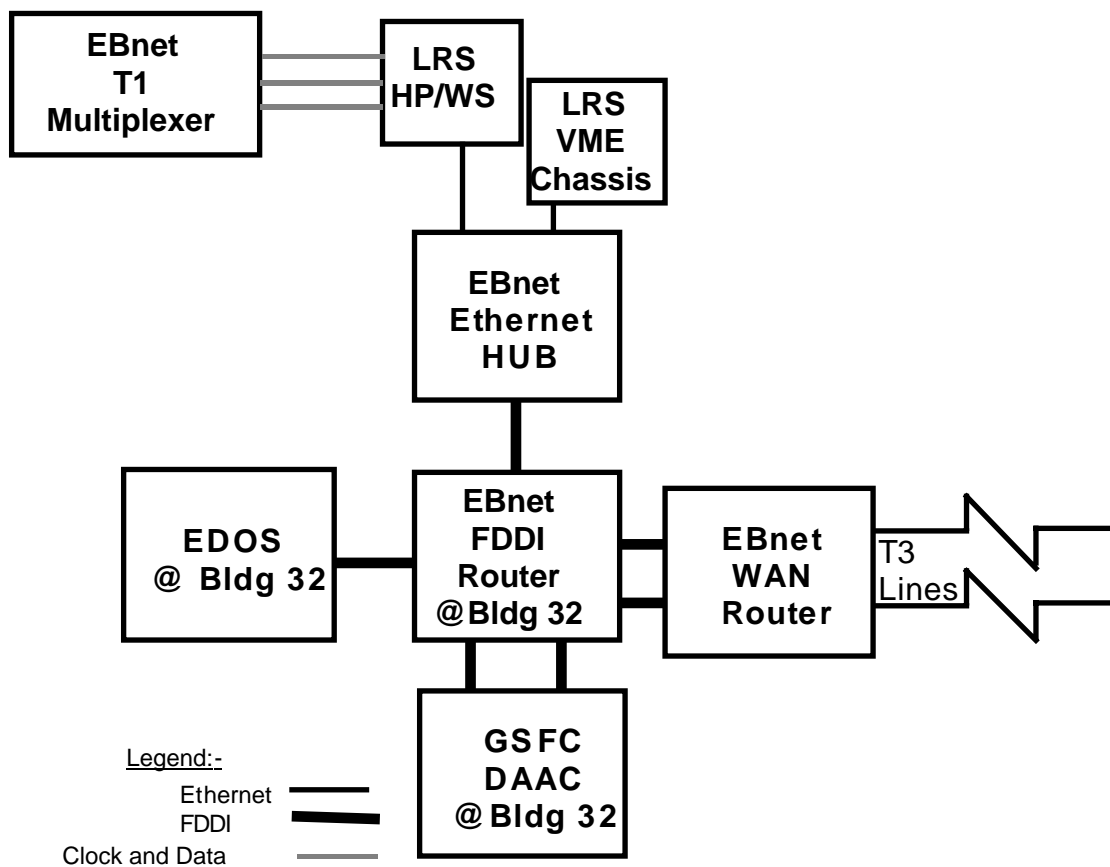
## Section 4. ETS-LRS Interface Detailed Design

### 4.1 Interface Design Overview

(A decision was reached within the ESDIS Project in June 1997 to close out the LRS development activity, prior to its completion. The LRS is currently located in the ETS lab in Building 25 at GSFC).

The EBnet to ETS-LRS interface design is depicted in Figure 4-1. This section describes in detail the design for the EBnet to ETS-LRS interface but also includes information which is relevant to the interface between EBnet and the other ETS components (MPS and HRS).

The physical components of the ETS-LRS include a Hewlett-Packard (HP) workstation (WS), which provides the user interface for system control and monitoring functions, and the Versa Module Eurocard (VME) chassis, which contains the VME cards needed to perform the required command and telemetry processing functions.



**Figure 4-1. ETS Operational Interface**

## **4.2 ETS-LRS Interface Design Assumptions**

Two types of interfaces with EBnet are required for the ETS-LRS:

- Serial clock and data between the SCITF in VFPA (for SCS and SSIM) and the ETS-LRS at GSFC.
- Ethernet IP network connections between the ETS-LRS and EOC at GSFC.

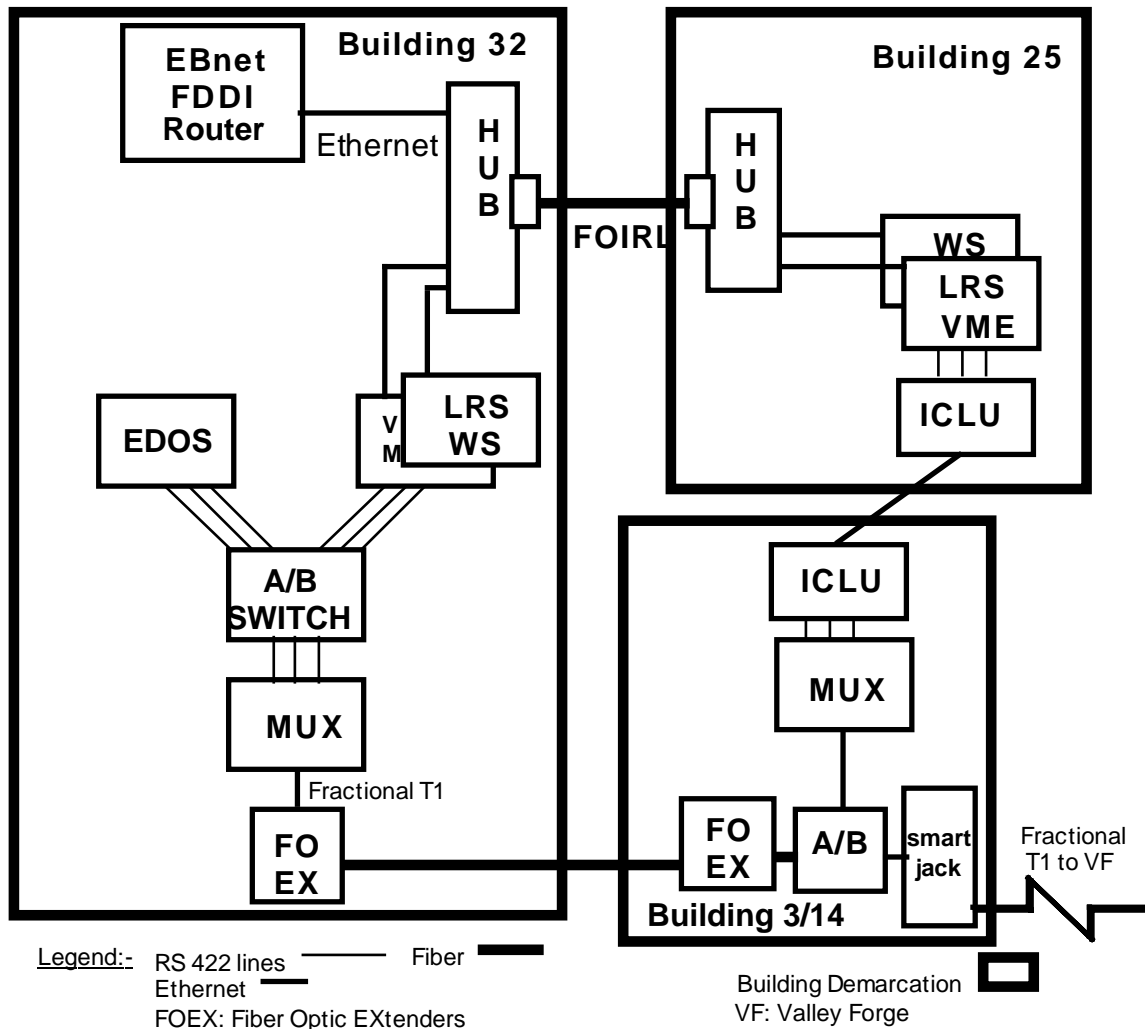
The ETS-LRS will be developed and tested at GSFC in Building 25 (Rm N155.) EBnet connectivity will be required for the ETS-LRS while it is at Building 25 prior to being installed for operations in the EOC in Building 32 (Rm C210).

### **4.2.1 Data Interface Design**

The EBnet and LRS interface design for IP support, as shown in Figure 4-2, consists of a pair of Institute of Electrical and Electronics Engineers (IEEE) 802.3-compliant 10Base-T Ethernet hubs connected by a Fiber Optic Inter-Repeater Link (FOIRL). One hub is located in Building 25 to support the LRS during development. One hub is located in Building 32 to support the LRS upon relocation from building 25. The LRS components are connected to the hubs using 10Base-T connections. An EBnet FDDI switch will extend these connections to support ETS interfaces with the EOC. The EBnet switch located in the EOC will carry the ETS data interface to the EOC LAN Router. The ETS-LRS requires two physical connections to the EBnet Ethernet hub: one to/from the HP/WS, and the other to/from the master controller in the VME chassis. Nine IP addresses are needed for the ETS-LRS, including two for the workstation and seven for the VME cards (see Table 4-1).

The EBnet and LRS interface design for clock and data support, as shown in Figure 4-2, consists of a pair of T1 multiplexers, fiber optic extenders (FO EX), a fiber optic patch panel and a RS-422/449 A/B switch. The fractional T1 service from Valley Forge will terminate in the Building 3/14 carrier demarc room (N37.) This service will be fed into a T1 A/B switch. The A output of the switch will be fed to a T1 multiplexer. This multiplexer will convert the T1 aggregate into the 2 telemetry and 1 command channel required by the LRS. These 3 RS-422/449 interfaces will be extended to building 25 through the use of the Interbuilding Communication Link Upgrade (ICLU) facility. This facility consists of FOTs and dedicated fiber optic cables. The FOTs will drive the RS-422/449 signals between Building 25 and Building 14. The “B” output of the T1 A/B switch will be fed to an FO EX for conversion from the electrical T1 interface to a fiber optic interface. This fiber optic interface will be fed the FO EX in Building 32. In building 32, the fiber will terminate at another FO EX for conversion from a fiber optic interface to an electrical T1 interface. The electrical T1 interface is fed to a T1 multiplexer which converts the aggregate T1 stream to the individual RS422/449 telemetry and command links. Within Building 32, these RS422/449 links are fed to an

A/B switch. The A/B switch allows selection between the LRS VME chassis and the EDOS Operational Prototype (EOP.) It is important to note that upon relocation of the LRS from Building 25 to Building 32, the Building 25 clock and data infrastructure is no longer required.



**Figure 4-2. LRS Interface**

### 4.3 Overview of System Interfaces

The protocols at each layer of the International Organization for Standardization (ISO) seven-layer model that will be supported are described in the following subsections.

#### 4.3.1 Physical Layer

EBnet will support the following physical layer:

- Electronic Industries Association's (EIA's) RS-422 standard.
- EIA's RS-449 standard.

EBnet will support the following Ethernet interface to the ETS-LRS:

- IEEE 802.3, 10BaseT (unshielded twisted pair) with RJ45 connectors.

#### **4.3.2 Data Link Layer Protocol**

EBnet will support the following data link layer protocols:

- ISO 8802-2, Logical Link Control (LLC).
- ISO 8802-3, Carrier-Sense Multiple-Access with Collision Detection (CSMA/CS) Media Access Control (MAC)-Ethernet Version 2.0 is supported.

The EBnet-supported clock and data interface to the ETS-LRS is transparent at layer 2.

#### **4.3.3 Network Layer Protocol**

EBnet will provide the following network layer protocols:

- Internet Protocol (IP) version 4.
- Internet Control Message Protocol (ICMP).
- Address Resolution Protocol (ARP).
- Internet Group Multicast Protocol (IGMP).
- Routing Information Protocol (RIP) (RFC 1058).

The EBnet-supported clock and data interface to the ETS-LRS is transparent at layer 3.

#### **4.3.4 Transport Layer Protocol**

The EBnet-supported IP and clock and data interfaces to the ETS-LRS are transparent at layer 4.

#### **4.3.5 Session Layer**

The EBnet-supported IP and clock and data interfaces to the ETS-LRS are transparent at layer 5.

#### **4.3.6 Presentation Layer**

The EBnet-supported IP and clock and data interfaces to the ETS-LRS are transparent at layer 6.

#### **4.3.7 Application Layer**

The EBnet-supported IP and clock and data interfaces to the ETS-LRS are transparent at layer 7.

#### **4.3.8 Network/Station Management Protocols**

EBnet shall support, at a minimum, the following management protocols:

- a. Simple Network Management Protocol (SNMP).
- b. FDDI Station Management (SMT) 6.2 or higher.

### **4.4 Routing and Addressing Guidelines**

EBnet will utilize standard IP addressing conventions. EBnet will provide Class C subnet addresses to a connected user if required. ETS will be assigned a total of 34 IP addresses as per Table 4-1 for all three subsystems. It is important to note that the ETS design uses internal and external network connections. Internal connections are for ETS to ETS connectivity (i.e., invisible to EBnet) and external connections are for ETS to EBnet connectivity. Some ETS assigned IP addresses will be used on internal connections and some will be used on external connections. This is defined in Table 4-1.

**Table 4-1. ETS Interfaces that Require an IP Address**

SYSTEM	INTERFACE NOMENCLATURE	# of IP	EBNET INTERFACE TYPE	INTERNAL/ EXTERNAL IP
<b>H R S</b>	Master Controller	2	1 Ethernet	1 Int/1 Ext
	Simulator	1		1 Int
	Reed Solomon	1		1 Int
	Service Processor	1		1 Int
	Frame Synchronizer	1		1 Int
	Annotation Processor	2		2 Int
	Data Set Processor 1	2	1 FDDI	1 Int/1 Ext
	Data Set Processor 2	2		2Int
	Work Station	3	1 Ethernet	2 Int/1 Ext
	Tape Recorder	2	1 Ethernet	1 Int/1 Ext
<b>L R S</b>	Master Controller	2	1 Ethernet	1 Int/1 Ext
	Front End Processor 1	1		1 Int
	Front End Processor 2	1		1 Int
	Simulator	1		1 Int
	Service Processor	1		1 Int
	Forward Link I/F Card	1		1 Int
	Work Station	2	1 Ethernet	1 Int/1 Ext
<b>M P S</b>	Simulator (MPS1)	1	1 Ethernet	1 Ext
	Front End Processor (MPS1)	1	1 Ethernet	1 Ext
	PC Laptop (MPS1)	1	1 Ethernet	1 Ext
	X-Terminal (MPS1)	1		
	Simulator (MPS2)	1		
	Front End Processor (MPS2)	1		
	PC Laptop (MPS2)	1		
	X-Terminal (MPS2)	1		

## 4.5 Data Flow Requirements

The data flow requirements for this circuit are within the design criteria for the equipment involved in the design of this circuit. Table 4-2 describes ETS interfaces provided by EBnet.

**Table 4-2. ETS Interfaces Provided by EBnet Project**

<b>ETS Unit (Location)</b>	<b>ETS Interface to:</b>	<b>EBnet Interface</b>	<b>Performance Requirements</b>
HRS (EDOS@GSFC)	EDOS for receiving data sets and exchanging OMD	Local FDDI and Ethernet interfaces	34 Mbps for data sets, 49 kilobits per second (Kbps) for OMD
	DAACs for sending data sets and exchanging OMD	Local FDDI and Ethernet interfaces	34 Mbps for data sets, 49 Kbps for OMD
LRS* (EOC@GSFC)	SCS at VFPA	Clock and data, 3 channels, RS-422	16 Kbps for telemetry channel 1, 512 Kbps for telemetry channel 2, 10 Kbps for command channel
	SSIM at VFPA	Clock and data, 3 channels, RS-422	16 Kbps for telemetry channel 1, 16 Kbps for telemetry channel 2, 10 Kbps for command channel
	EOC for sending low-rate telemetry and OMD and receiving commands	Local Ethernet interface	70 Kbps for packets, 700 Kbps for file transfers, 49 Kbps for OMD, 10 Kbps for commands
MPS (EOC@GSFC)	EOC for sending low-rate telemetry and OMD and receiving commands	Local Ethernet interface	70 Kbps for packets, 700 Kbps for file transfers, 49 Kbps for OMD, 10 Kbps for commands

\* The LRS development was closed out.

## 4.6 Equipment List

EBnet will provide the following equipment to support this interface:

- Hub: Cabletron (24-port 10Base-T Hub) (2 each).
- Multiplexer: Timplex Multiplexer Link/2 with integral Data Service Unit/Channel Service Unit (DSU/CSU) (3 each).
- Fiber Patch Panel.
- Fiber Optic Extenders: Optelecom (Model 4632) Three (3 each).
- RS-449 A/B Switch: South Hills Data Comm.
- Optic Transceiver: Cabletron Fiber Transceiver (Model 8010-fO1-ST) (2 each).

## **Section 5. ETS-HRS Interface Design**

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### **5.1 Interface Design Overview**

The ETS HRS provides a test data source of science data to EDOS and supports tests and simulations requiring the transmission and reception of data sets. The ETS-HRS has three major components: an HP WS, which provides the user interface for system control and monitoring functions; a VME chassis, which contains the VME cards needed to perform the required data set handling functions; and a Tape Recorder Subsystem (TRS), which provides a mechanism to incorporate user-provided spacecraft data tapes for ETS transmitted data streams.

The ETS-HRS interface design consists of three physical Ethernet connections and one physical FDDI connection to EBnet. The ETS-HRS requires EBnet interfaces for connections to EDOS and the EOS AM-1 DAACs.

### **5.2 Design Assumptions**

Two types of interfaces with EBnet are required for the ETS-HRS:

- FDDI IP network connection.
- Ethernet IP network connections.

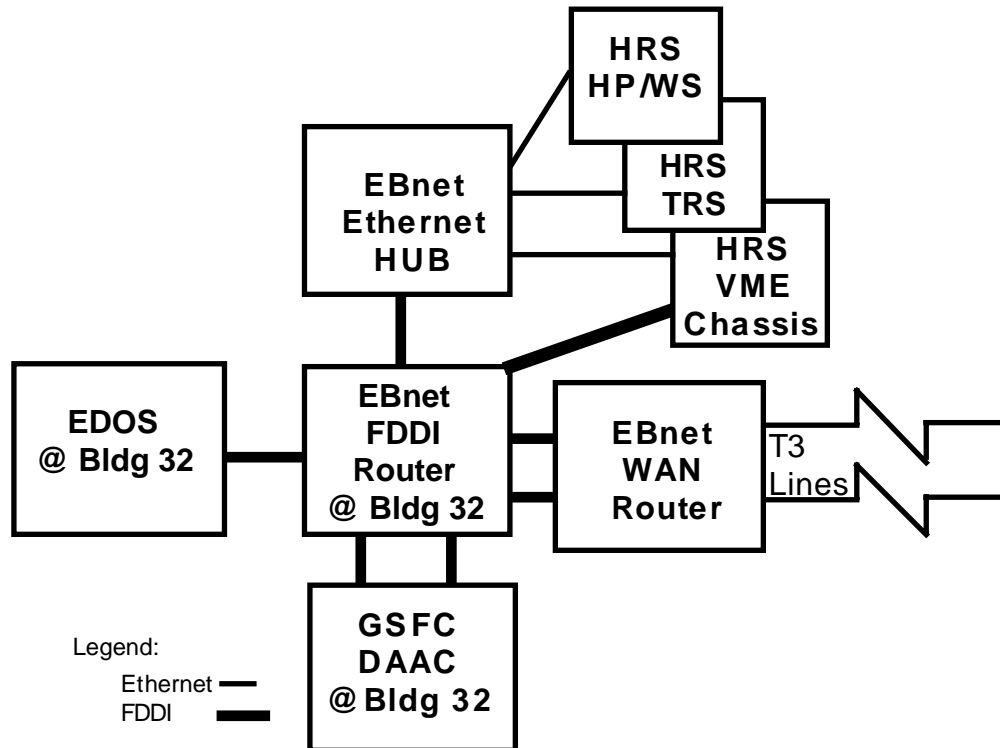
The ETS-HRS is installed for operational test support in Building 32, Room S9. EBnet connections are required for IP network interfaces when the HRS is installed in Building 32.

The ETS-HRS supports fully compatible network with 4.3 Berkeley Software Distribution (BSD) Tahoe UNIX Network. It supports Transmission Control Protocol (TCP)/IP and User Datagram Protocol (UDP)/IP.

### **5.3 Data Interface Design**

The data interface design provides a primary communication between the ETS-HRS and EDOS or a DAAC for a given test or simulation. The ETS-HRS requires a bandwidth to support up to 25 GB per data transfer at a rate of up to 34 Mbps over a FDDI network. Figure 5-1 depicts HRS interface to EBnet.

The EBnet and HRS interface design, as shown in Figure 5-1, consists of an Ethernet hub and an FDDI switch both located in Building 32. The hub is connected to the switch via a 10Base-T connection. Each HRS component (VME, HP/WS, TRS) is connected to the Ethernet hub via a 10Base-T connection. One of the VME storage components is connected to the FDDI switch via a standard MIC terminated multimode FDDI fiber. A total of 11 IP addresses are required by the HRS including 3 for the HP/WS, 2 for the TRS and 12 for the VME cards (see Table 4-1).



**Figure 5-1. HRS Interface**

## 5.4 Overview of System Interfaces

The protocols at each layer of the International Organization for Standardization (ISO) seven-layer model that will be supported are described in the following subsections.

### 5.4.1 Physical Layer

EBnet will support the following physical layer connections:

- IEEE 802.3, 10BaseT (unshielded twisted pair) with RJ45 connectors.
- ISO 9314-1, FDDI PHY.
- ISO 9314-3, FDDI PMD.

### 5.4.2 Data Link Layer Protocol

EBnet will support the following data layer connections:

- ISO 8802-2, LLC.
- IOS 8802-3, CSMA/CD MAC-Ethernet Version 2.0 is supported.
- ISO 9314-2, FDDI MAC Protocol.

### **5.4.3 Network Layer Protocol**

The EBnet-supported Ethernet interface to the ETS-HRS at layer 3 shall conform to the following:

EBnet will support the following network protocols to the ETS-HRS:

- IP version 4.
- ICMP.
- ARP.
- IGMP.
- RIP.

### **5.4.4 Transport Layer Protocol**

The EBnet-supported IP interfaces to the ETS-HRS are transparent at layer 4.

### **5.4.5 Session Layer**

The EBnet-supported IP interfaces to the ETS-HRS are transparent at layer 5.

### **5.4.6 Presentation Layer**

The EBnet-supported IP to the ETS-HRS are transparent at layer 6.

### **5.4.1 Application Layer**

The EBnet-supported to the ETS-HRS are transparent at layer 7.

### **5.4.8 Network/Station Management Protocols**

EBnet shall support, at a minimum, the following management protocols:

- a. SNMP.
- b. FDDI SMT 6.2 or higher.

## **5.5 Data Flow Requirement**

There are four paths of data flow for the ETS-HRS: VME chassis to DAAC, EDOS to VME chassis, HP WS to/from DAAC, and HP WS to/from EDOS.

The ETS-HRS transfers EDSs and PDSs from the VME chassis to a DAAC over the FDDI network connection at a maximum rate of 34 Mbps. The ETS-HRS receives EDSs and PDSs from EDOS over the FDDI network connection at a maximum rate of 34 Mbps.

ETS application software residing on the HP WS sends and receives OMD messages to EDOS and the DAACs over an Ethernet connection to EBnet at data rates up to 49 Kbps.

## **Section 6. ETS-MPS Interface Design**

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### **6.1 Interface Design Overview**

The ETS MPS serves as a basic, low-rate spacecraft simulator. The ETS-MPS consists of an X-terminal, a personal computer (PC) laptop, and a VME chassis.

The ETS-MPS interface design consists of four physical Ethernet connections to EBnet. For the MPS unit supporting EOC testing, EBnet will extend these connections to the EOC.

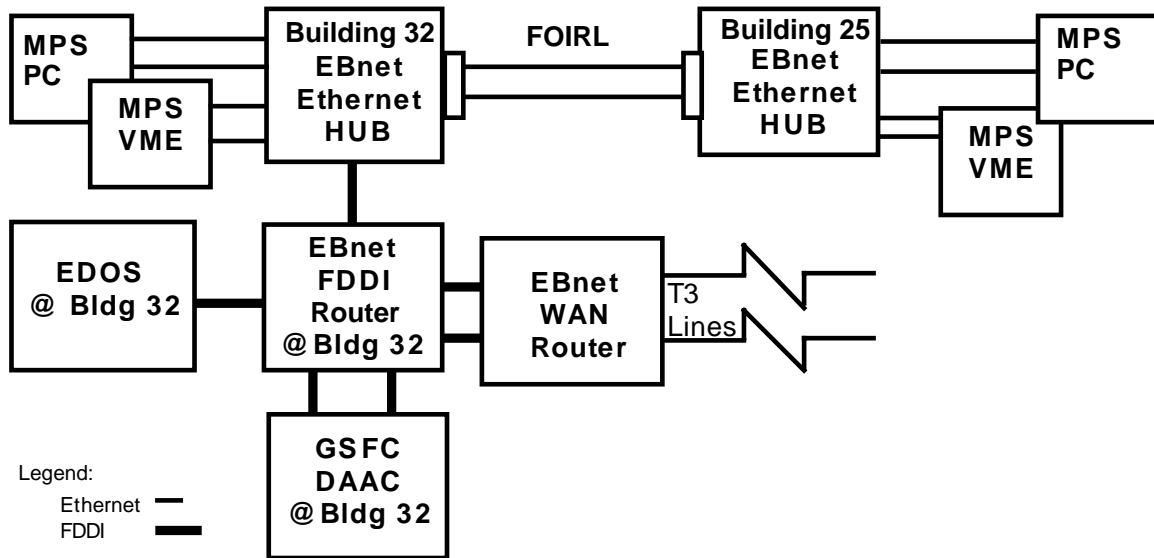
### **6.2 Design Assumptions**

The ETS-MPS supports TCP/IP and UDP/IP from the VME input/output cards and the UNIX System V-based front-end processor which is hosted on a single board computer within the VME chassis. Each of the two ETS-MPS units requires a total of four IP addresses for its four Ethernet interfaces, which are the VME sim card, the VME front-end processor card, and the X-terminal and PC laptop, either of which can function as the user control monitor.

The ETS-MPS will be developed and tested at GSFC in Building 25 (Rm N155.) EBnet connectivity will be required for the ETS-MPS while it is at Building 25 prior to being installed for operations in the EOC in Building 32 (Rm C210H ).

### **6.3 Data Interface Design**

The EBnet and MPS interface design, as shown in figure 6-1 consists of an Ethernet hub. The MPS components are connected to the hub via 10Base-T connections. The hub is connected to an EBnet FDDI switch via a 10Base-T connection. A total of three IP addresses are required by each of the two MPS units the MPS including 2 for the PC/X-stations and 2 for VME cards (see Table 4-1). The hub is connected to an EBnet FDDI router via a 10Base-T connection.



**Figure 6-1. MPS Interface**

## 6.4 Overview of System Interfaces

The protocols at each layer of the ISO seven-layer model that will be supported are described in the following subsections.

### 6.4.1 Physical Layer

EBnet will support the following physical layer connections:

- IEEE 802.3, 10BaseT (unshielded twisted pair) with RJ45 connectors.

### 6.4.2 Data Link Layer Protocol

EBnet will support the following physical layer connections:

- ISO 8802-2, LLC.
- ISO 8802-3, CSMA/CD MAC-Ethernet Version 2.0 is supported.

### 6.4.3 Network Layer Protocol

The EBnet-supported Ethernet interface to the ETS-MPS at layer 3 shall conform to the following:

- IP version 4.
- ICMP.
- ARP.

- IGMP.
- RIP (RFC 1058).

#### **6.4.4 Transport Layer Protocol**

The EBnet-supported IP interfaces to the ETS-MPS are transparent at layer 4.

#### **6.4.5 Session Layer**

The EBnet-supported IP interfaces to the ETS- MPS are transparent at layer 5.

#### **6.4.6 Presentation Layer**

The EBnet-supported IP to the ETS- MPS are transparent at layer 6.

#### **6.4.1 Application Layer**

The EBnet-supported to the ETS- MPS are transparent at layer 7.

#### **6.4.8 Network/Station Management Protocols**

EBnet shall support, at a minimum, the following management protocols:

- a. SNMP.
- b. FDDI SMT 6.2 or higher.

### **6.5 Data Flow Requirement**

There are three paths of data flow for the ETS-MPS: VME sim card to/from EOC, VME front-end processor card to/from EOC, and X-terminal or PC front-end to/from EOC.

The ETS-MPS VME sim card receives command data blocks from the EOC and transfers real-time and rate-buffered test data to the EOC over an Ethernet connection. The maximum data rate for commands is 10 Kbps, for the real-time packets is 10 Kbps, and for the file transfers is 100 Kbps.

The ETS-MPS VME front-end processor card sends OMD messages to the EOC over Ethernet at a maximum data rate of 49 Kbps.

The ETS-MPS X-terminal/PC front-end provides a status and control interface to the EOC through an Ethernet connection.

## **Section 7. Facilities and Maintenance Demarcation**

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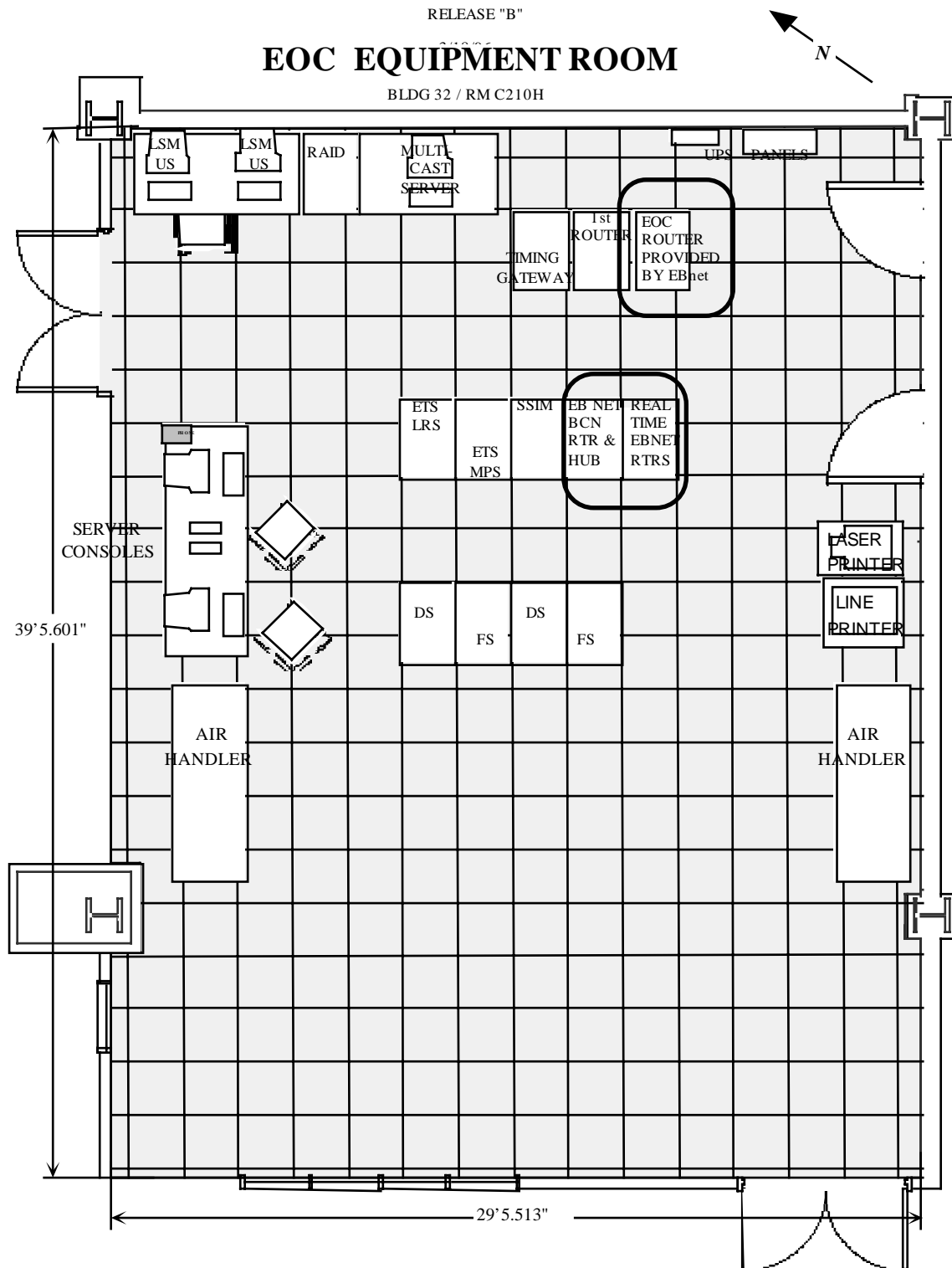
### **7.1 Equipment Location**

The ETS units will be developed and tested in Building 25 room N155 at GSFC. Initial connectivity from Building 25 to Building 32 will be required for informal testing prior to delivery of ETS systems to the Earth Science Data and Information System (ESDIS) Project.

The ETS-HRS and one ETS-MPS unit will be installed and operated from the EDOS facility at Building 32. The ETS-LRS and a second ETS-MPS unit will be installed and operated from the EOC facility in Building 32. The LRS development activity was closed out.

### **7.2 Maintenance Demarcation**

Maintenance demarcation for this interface will be its interconnection with EBnet at EBnet's physical location. All cabling between the EBnet equipment and the ETS will be ETS's responsibility. A floor layout of ETS equipment in the EOC is shown in Figure 7-1.



**Figure 7-1. EOC Equipment Room Layout**

## Abbreviations and Acronyms

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ARP	Address Resolution Protocol
BSD	Berkeley Software Distribution
CADU	Channel Access Data Unit
CCB	Configuration Control Board
CLCW	Command Link Control Word
COP	Command Operations Procedure
CSMA/CD	Carrier-Sense Multiple-Access with Collision Detection
DAAC	Distributed Active Archive Center
DCN	Document Change Notice
DSU/CSU	Data Service Unit/Channel Service Unit
EBnet	EOSDIS Backbone Network
EDOS	EOS Data and Operations System
EDU	EDOS Data Unit
EGS	EOS Ground System
EIA	Electronic Industries Association
EOC	EOSDIS Operations Center
EOP	EDOS Operational Prototype
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ESDIS	Earth Science Data and Information System
ETS	EOSDIS Test System
FDDI	Fiber Distributed Data Interface
FOEX	Fiber Optic EXtenders
FOIRL	Fiber Optic Inter Repeater Link
FOT	Flight Operations Team
GB	gigabyte
GSFC	Goddard Space Flight Center

HP	Hewlett-Packard
HRS	High-Rate System
ICD	Interface Control Document
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronic Engineers
IGMP	Internet Group Multicast Protocol
IONET	IP Operational Network
IP	Internet Protocol
IRD	Interface Requirements Document
ISO	International Organization for Standardization
LAN	Local Area Network
LLC	Logical Link Control
LRS	Low-Rate System
MAC	Media Access Control
Mbps	megabits per second
MO&DSD	Mission Operations and Data Systems Directorate
MPS	Multimode Portable Simulator
MTTRS	Mean Time to Restore Service
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NI	NASA Internet
OMD	Operations Management Data
OSPF	Open Shortest Path First
PC	Personal Computer
PDS	Production Data Set
RFC	Request for Comment
RIP	Routing Information Protocol
Rm.	Room
SCITF	Spacecraft Integration and Test Facility

SCS	Spacecraft Checkout Station
Sim	simulation
SMT	Station Management
SN	Space Network
SNMP	Simple Network Management Protocol
SSIM	Spacecraft Simulator
TCP	Transmission Control Protocol
TDRSS	Tracking and Data Relay Satellite System
TGT	TDRSS Ground Terminal
TRS	Tape Recorder Subsystem
UDP	User Datagram Protocol
VFPA	Valley Forge, Pennsylvania
VME	Versa Module Eurocard
WAN	Wide Area Network
WS	workstation
WSC	White Sands Complex
ICLU	Interbuilding Communication Link Upgrade
COMMGR	Communication Manager
PHY	Physical Layer protocol
PMD	Physical Layer Medium Dependent

